Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
ECHOSTAR SATELLITE CORPORATION	)	
	)	File No. ________________
Application for Authority to Construct, Launch And Operate a Geostationary Satellite Using The Extended Ku-band Frequencies in the Fixed-Satellite Service at the 109° W.L. Orbital Location	)	

APPLICATION

Pursuant to Sections 308, 309 and 319 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 308, 309 and 319, Part 25 of the Commission's rules, 47 C.F.R. Part 25, and the Commission's *First-Come-First-Served Report and Order* ("*FCFS Order*"),[1] EchoStar Satellite Corporation ("EchoStar") hereby re-files an application for authority to construct, launch and operate a geostationary ("GSO") satellite in the Fixed-Satellite Service ("FSS") using the extended Ku-band frequencies (10.95-11.2 GHz and 11.45-11.7 GHz downlink; 13.75-14.0 GHz uplink) at the 109° W.L. orbital location.[2] In accordance with the *FCFS Order*, the

[1] *In the Matter of Amendment of the Commission's Space Station Licensing Rules and Policies*, IB Docket No. 02-34, First Report and Order and Further Notice of Proposed Rulemaking, FCC 03-102 (rel. May 19, 2003) ("*FCFS Order*").

[2] By letter dated December 8, 2003, the International Bureau dismissed EchoStar's application for a satellite to be located at the same orbital slot with the same set of extended Ku-band frequencies. *See* Letter from Thomas S. Tycz, FCC to David K. Moskowitz, EchoStar Satellite Corporation (Dec. 8, 2003). This application is being re-filed in order to correct the asserted deficiencies with the previously dismissed application.

addition of this application will *not* cause EchoStar to exceed the five-satellite limit for licensed-but-unbuilt and pending applications in the extended Ku-band frequencies.[3]

As the Commission is well aware, EchoStar is a leading provider of Direct Broadcast Satellite ("DBS") services in the multichannel video programming distribution ("MVPD") market with over 9 million subscribers. EchoStar and its affiliates own and operate eight DBS satellites at the 61.5° W.L., 110° W.L., 119° W.L., 148° W.L. and 157° W.L. orbital locations, as well as a hybrid Ka-/Ku-band FSS satellite at the 121° W.L. orbital location. The proposed satellite will supplement and support EchoStar's existing MVPD offerings with more local-into-local channels and international programming.

This satellite application satisfies the requirements for first-come-first-served processing under the *FCFS Order*, and EchoStar requests that it be placed in the appropriate position in the first-come, first-serve ("FCFS") queue based on its filing date and time.

I. GENERAL DESCRIPTION

The Technical Annex (*see* Exhibit 1) contains a detailed description of the technical specifications of the proposed satellite and is incorporated into this narrative by reference. EchoStar also supplies, as Exhibit 2, all necessary Advance Publication Information for transmittal to the International Telecommunication Union ("ITU").

In summary, the proposed extended Ku-band satellite will operate with 32 transponders each of 27 MHz usable bandwidth, meaning full frequency reuse of the 500 MHz downlink frequencies and four-fold frequency reuse of the 250 MHz uplink frequencies by

[3] *See FCFS Order* at ¶¶ 230-231. In this regard, EchoStar notes that three of its pending extended Ku-band FSS applications at these locations were dismissed by the Commission, without prejudice to refiling, on December 8, 2003. This application replaces one of the dismissed applications and, as such, it is not subject to an application filing fee, 47 C.F.R. § 1.1109(d).

means of both polarization and spatial isolation. The proposed satellite will operate using a broad coverage beam on the downlink. In addition, the proposed satellite will use two satellite receive beams for feeder link uplink transmissions. Both uplink beams are steerable and can be used to receive uplinks from various locations in other countries.

EchoStar will be uplinking transmissions from outside the United States and downlinking programming into the United States as well as possibly other countries, which clearly is international service in compliance with footnote NG104 of the U.S. Table of Allocations, 47 C.F.R. § 2.106 and footnote 2 of 47 C.F.R. § 25.202(a)(1). EchoStar may also be uplinking transmissions from within the United States if permitted to do so by the Commission. In EchoStar's view, a service with uplinks from the United States and downlinks to the United States and other countries should qualify as international service.[4] Because the Bureau has disagreed with this view, however, EchoStar hereby requests a waiver of footnote NG104 of the U.S. Table of Allocations, 47 C.F.R. § 2.106, and footnote 2 of 47 C.F.R. 25.202(a)(1), to allow uplink transmissions from within the United States and downlink programming to locations in the United States and elsewhere. *See* Section VII below. If its waiver request is granted, EchoStar envisions using one of the beams for uplink transmissions from an EchoStar earth station located at Cheyenne, Wyoming, while still using the other steerable beam to uplink transmissions (including international programming) directly from other countries (*e.g.* Canada, Mexico and Peru). If the waiver request is denied, EchoStar will conduct uplink transmissions exclusively from other countries, which would indisputably qualify the service as international.

[4] Among other things, a narrower reading of the term "international" would threaten to undo the Commission's First-Come, First-Served processing system, as the ORBIT Act's prohibition on auctions for "international" systems would not apply in cases of combined domestic and international services.

EchoStar plans to locate its TT&C earth station and satellite control facilities for the proposed satellite in the United States. TT&C is not a conventional communications link, and therefore cannot be considered in the context of being "domestic" or "international" in nature. Inevitably a TT&C link must uplink and downlink from the same earth station. For reliability, cost and other reasons that earth station should preferably be located within the United States. Therefore, EchoStar believes it is not necessary to obtain a waiver of footnote NG104 of the U.S. Table of Allocations, 47 C.F.R. § 2.106, and footnote 2 of 47 C.F.R. 25.202(a)(1), in order to allow a United States TT&C facility to control the proposed satellite. However, to the extent that the Commission believes that a waiver of the Rules is necessary for TT&C operations in the United States using the extended Ku-band frequencies, it hereby requests such a waiver. Should that waiver too be deemed necessary and denied, EchoStar is prepared to conduct TT&C operations from a foreign uplink center.

The proposed satellite will communicate with receive-only earth terminals in the extended Ku-band frequencies in the United States.[5] As the downlink beam will comply with the power flux density limits in 47 C.F.R. § 25.208(b), protection of the co-primary Fixed Service (FS) is assured. As for potential interference from FS terminals, EchoStar expects that its receive terminals can co-exist within this interference environment in most geographic areas of the country while maintaining an acceptable quality of service without any frequency coordination. Buildings, foliage and terrain will naturally block FS signals. In areas where the level of interference from FS transmitting stations into EchoStar receive terminals does reach unacceptable levels, a number of interference mitigation techniques can be employed, including careful placement of the receiver and/or additional shielding of the receive earth station.

[5] These earth terminals may have transmit capabilities in other frequency bands, but will not be transmitting in the extended Ku-band.

EchoStar does not envision the need for any frequency coordination with the FS stations for its smaller terminals.

II. SERVICES TO BE PROVIDED

EchoStar will use the proposed satellite to provide primarily three types of services:

- Direct-to-Home services, including bandwidth-intensive "local-into-local" and High Definition ("HD") services, to supplement the services provided today by EchoStar's DBS satellites and alleviate many of the spectrum constraints that have hampered its DBS offerings.
- Transport of programming to EchoStar's DBS uplink centers, to serve its increasing needs for feeding programming to these centers.
- International Direct-to-Home, broadband and programming transport services.

EchoStar proposes to offer Direct-to-Home services, interactive services and HD content to consumers using transactions modeled on the current relationship between EchoStar and its DBS subscribers, which (as the Commission is aware) is a non-common carrier relationship, or other non-common carrier transactions.

III. FINANCIAL QUALIFICATIONS – COST OF CONSTRUCTION, LAUNCH AND OPERATION

The *FCFS Order* abolished the requirement of submitting an estimate of the proposed system's cost, as well as the financial qualification requirements.[6] Nonetheless,

[6] *FCFS Order* at ¶ 164, app.B §§ 6 and 13 (deleting §§ 25.114(c)(13), 25.140(b)(3)-(4) and 25.140(c)-(d)).

EchoStar is amply qualified to finance the construction, launch and operation of the proposed satellite.

IV. LEGAL QUALIFICATIONS

EchoStar's legal qualifications are a matter of record and are also set forth in the Form 312 submitted today for this satellite.

V. MILESTONES

EchoStar will submit itself to the milestones contemplated by the Commission's new rules for satellite licensees as set forth in the *FCFS Order*.[7]

VI. PUBLIC INTEREST CONSIDERATIONS

The grant of this application clearly serves the public interest by allowing the provision of additional DTH services (including more local-into-local and High Definition ("HD") channels), programming transport, and international services.

DTH services. The proposed satellite will help EchoStar become more competitive with cable operators in the MVPD market. Specifically, EchoStar has been laboring under the twin handicap of finite DBS spectrum and the lack of a "return" link that could enable truly interactive satellite services. The DBS spectrum (up to 32 channels at each of a finite number of orbital locations) provides EchoStar with significantly less programming capacity than is available to digital cable systems. This limited spectrum must be used to provide local broadcast channels, national programming, HD content and interactive services across the entire United States. This spectrum constraint is exacerbated by the need to provide local broadcast channels by satellite to as many cities as possible and by the must-carry rules, as well as by consumer demand for more HD channels. In contrast, most cable systems can devote a full 750

[7] *See FCFS Order* at ¶ 174 (contract execution within 1 year; Critical Design Review within 2 years; Commence Construction within 3 years; and Launch and Operate within 5 years).

MHz or more in each MSA to provide local, national and HD programming, as well as interactive and data services.[8] Even with spot beam satellites, the use of a DBS channel to provide local stations in one city generally reduces the spectrum available for DBS services elsewhere in the nation. Indeed, the need for more spectrum alternatives appears to grow more acute by the day as EchoStar attempts to provide local channels to an increasing number of MSA's and as more HD channels become available.

While the proposed satellite certainly will not be enough to cure this spectrum shortage problem, it is imperative for EchoStar to deploy additional spectrum resources at orbital locations that can "view" the entire United States in order to lessen this widening competitive handicap.

Programming Transport. Grant of this application will help better serve EchoStar's increasing need for the efficient transport of programming to its uplink centers, to the ultimate benefit of DBS consumers.

International Services. EchoStar proposes to use the proposed satellite for various types of international services. In particular, EchoStar's DBS business plan is increasingly focused on international programming.[9] The proposed satellite will help EchoStar provide to its customers many channels of international programming, including Latin American programming that is especially popular to U.S. consumers of Hispanic origin. Subject to the satellite's coverage capabilities and the licensing requirements in other countries, as well as the applicable regulations regarding the size of earth stations in certain frequency bands, EchoStar is

[8] *Annual Assessment of the Status of Competition in the Market for the Delivery of Video Programming*, Ninth Annual Report, MB 02-145, FCC 02-338, at ¶ 23 tbl.3 (2002).

[9] *See* EchoStar Communications Corp., Press Release, *EchoStar's Dish Network to Launch up to 100 New International Satellite TV Channels This Summer* (Apr. 4, 2003).

also interested in developing business plans for international DTH and broadband services to consumers in those countries, starting with countries that have reached DTH/FSS bilateral agreements with the U.S.

VII. REQUESTS FOR WAIVER OF COMMISSION RULES

A. Waiver to Permit Domestic Service – Footnote NG104 of the U.S. Table of Allocations and Footnote 2 of 47 C.F.R. § 25.202(a)(1)

Pursuant to Section 1.3 of the Commission's Rules, EchoStar hereby requests waivers of NG104 of the U.S. Table of Allocations, 47 C.F.R. § 2.106, and footnote 2 of 47 C.F.R. § 25.202(a)(1) *to the extent necessary* to permit it to provide domestic service as well as international service from the proposed satellite.

Both NG104 and footnote 2 limit the use of the 10.95-11.2 GHz and 11.45-11.7 GHz downlink bands to "international systems" only. To the extent that EchoStar is uplinking from outside the United States and downlinking programming into the United States, the proposed satellite is an "international system." EchoStar further submits that its provision of mixed domestic/international services (uplinks from the U.S., downlinks serving both the U.S. and other countries) complies with the Commission's Rules for the use of the requested frequency bands. It recognizes, however, that the Bureau has taken a contrary view in dismissing its earlier filed application to construction, launch and operate a similar satellite at the same orbital location. Accordingly, EchoStar is requesting this waiver of the Rules to allow for both domestic and international services using the proposed satellite.

Commission rules may be waived "for good cause shown."[10] In particular, a waiver of the Table of Allocations to permit non-conforming spectrum uses is generally granted "when there is little potential interference into any service authorized under the Table of

[10] 47 C.F.R. § 1.3; *WAIT Radio v. FCC*, 418 F.2d 1153, 1157 (D.C. Cir. 1969).

Frequency Allocations and when the non-conforming operator accepts any interference from authorized services."[11] A waiver is also appropriate where a grant "would not undermine the underlying policy objectives of the rule in question" and would be in the public interest.[12]

In this case, there is good cause for the requested waivers. The placement of receive-only antennas on an uncoordinated basis in the United States will not inhibit or otherwise negatively impact the operations of FS stations in the extended Ku-band. The downlink beams from the proposed satellite will comply with the power flux density limits in the Commission's Rules, thus fully protecting FS operations from interference. With respect to potential interference from FS operations, EchoStar expects that its receive terminals can co-exist with FS stations in most geographic areas of the country while maintaining an acceptable quality of service. Buildings, foliage and terrain will naturally block FS signals. In areas where the level of interference from FS transmitting stations into EchoStar receive terminals is high, a number of interference mitigation techniques can be employed, including careful placement of the receiver and/or additional shielding of the receive earth station. In any event, EchoStar will accept any level of interference from FS stations into its earth stations in the extended Ku-band.

Moreover, the requested waivers of footnote NG104 of the U.S. Table of Allocations and footnote 2 of 47 C.F.R. § 25.202(a)(1) would not undermine the underlying policy objective of those two rules – "namely to minimize the overall number of earth stations in

[11] *See The Boeing Company*, Order and Authorization, 16 FCC Rcd. 22645, 22651 ¶ 12 (Int'l Bur. 2001); *Fugro-Chance, Inc.*, Order and Authorization, 10 FCC Rcd. 2860, 2860 ¶ 2 (Int'l Bur. 1995) (authorizing non-conforming MSS in the C-band); *see also Motorola Satellite Communications, Inc.*, Order and Authorization 11 FCC Rcd. 13952, 13956 ¶ 11 (Int'l Bur. 1996) (authorizing service to fixed terminals in bands allocated to the mobile-satellite service).

[12] *See GE American Communications, Inc.*, Order and Authorization, 15 FCC Rcd. 3385, 3391 ¶ 14 (Int'l Bur. 1999).

order to limit the areas in which future terrestrial fixed service would be precluded."[13] In this case, FS operations will not be impacted by EchoStar's operations in the United States because of the proposed use of receive-only earth stations that can accept interference from FS stations without any frequency coordination.[14] Accordingly, the Bureau should waive those restrictions here.

The grant of the requested waivers will also serve the public interest as the proposed satellite will supplement and support EchoStar's existing MVPD offerings (*i.e.* more local-into-local channels and international programming). These services will enable EchoStar to compete more effectively with its dominant competitors, the incumbent cable operators.[15]

In any event, even if the Commission were to deny the requested waivers, EchoStar is prepared to conduct uplink transmissions exclusively from other countries. A service consisting of uplinks from outside the U.S. and downlinks into the U.S. indisputably qualifies as international even under a narrow interpretation of the term. Therefore, even if EchoStar's waiver request were to be denied, this application should be granted on the condition that the proposed satellite only be used to provide international service. If this were the case, EchoStar will comply with the requirements of footnote NG104 and footnote 2 of 47 C.F.R. § 25.202(a)(1) by only pointing the steerable uplink beams at points outside the United States.

[13] *Id*. at 3392 ¶ 15.

[14] This is the key difference between EchoStar's proposal in this application and GE's proposal in *GE American*, *id*., namely that EchoStar's receive-only terminals (unlike GE's) will not need to be coordinated with FS stations (or vice versa) in the downlink band. *Compare id.* at 3390 ¶ 12 (noting GE's proposal that "any interference concerns that arise can be dealt with through the coordination process.").

[15] See Section VI., *supra*, for more on the public interest benefits that would be realized from licensing the proposed satellite.

B. Waiver to Permit TT&C Operations in the United States – Footnote NG104 of the U.S. Table of Allocations and Footnote 2 of 47 C.F.R. § 25.202(a)(1)

In addition, to the extent that the Commission believes that waivers of footnote NG104 of the U.S. Table of Allocations and footnote 2 of 47 C.F.R. § 25.202(a)(1) are also necessary for TT&C operations in the United States using the extended Ku-band frequencies, EchoStar hereby requests such waivers.

As previously noted, EchoStar plans to locate its TT&C earth station and satellite control facilities for the proposed satellite in the United States. TT&C is not a conventional communications link, and therefore cannot be considered in the context of being "domestic" or "international" in nature. Consequently, EchoStar believes it is not necessary to obtain a waiver of footnote NG104 of the U.S. Table of Allocations, 47 C.F.R. § 2.106, and footnote 2 of 47 C.F.R. 25.202(a)(1), in order to allow a United States TT&C facility to control the proposed satellite.

However, if the Commission considers that a waiver of these two Rules is necessary for TT&C operations in the United States using the extended Ku-band frequencies, EchoStar hereby requests such a waiver. There is good cause to waive these rules for TT&C purposes. Inevitably, a TT&C link must uplink and downlink from the same earth station. For reliability, cost and other reasons that earth station should preferably be located within the United States. Waiving these rules will also ensure that a U.S.-licensed satellite is controlled from an earth station in the United States. In addition, a waiver of these rules for TT&C purposes would not undermine the policy of the rules because TT&C operations would be conducted from only one (or perhaps only a small number) of earth stations within the United

States.[16] In any event, if the Bureau believes that a waiver of these rules for TT&C is necessary and if it were to deny this waiver request, EchoStar is prepared to conduct TT&C communications too from an uplink center located outside the U.S.

C. Waiver to Permit Use of Circular Polarization – 47 C.F.R. § 25.210(f)

EchoStar also requests a waiver of 47 C.F.R. § 25.210(f) to the extent required to permit operation of the proposed extended Ku-band payload by way of circular polarization.[17] There is good cause for this requested waiver. In the extended Ku-band, circular polarization is more efficient because it minimizes the installation cost for the small consumer premises receive-only earth stations, which are expected to be deployed in large numbers. The use of linear polarization would require additional adjustment capability on the earth station antenna mounts and additional setup procedures for the installer to ensure correct rotational alignment of the earth station feeds. These factors would translate to higher costs to the subscribers and increased risk of rotational misalignment, and hence unwanted interference, throughout the lifetime of the earth station.[18] The use of circular polarization will avoid these costs. Moreover, all of EchoStar's existing DBS operations use circular polarization for both the uplinks and

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[16] *See*, *e.g.*, *The Boeing Company*, Order and Authorization, 18 FCC Rcd. 12317 at ¶ 15 (Int'l Bur. 2003) (explaining that "it would not disserve the policy objective of NG104" to permit NGSO FSS and GSO MSS systems to use the extended Ku-band frequencies for feeder link operations "because the total number of such gateway stations would be relatively small" and "may [therefore] present fewer constraints for terrestrial systems . . . .").

[17] In fact, the polarization of the extended Ku-band payload is fully switchable between linear and circular, and therefore the proposed satellite can comply with 47 C.F.R. § 25.210(f) even if the requested waiver were not to be granted.

[18] For these reasons, circular polarization has become a component of state-of-the-art satellite design for the Ku-band. *See*, *e.g.*, Public Notice, Report No. SAT-00137 (rel. Feb. 24, 2003) (SES Americom, Inc. requesting any necessary waiver to permit circular polarization in the Ku-band for the AMC-15 satellite).

downlinks, and use of circular polarization for the proposed extended Ku-band payload would therefore be beneficial for EchoStar.

The foregoing benefits will not be accompanied by any detriment. The use of circular polarization in the extended Ku-band will not give rise to any increased interference to or from adjacent satellite networks that might be using linear polarization. The predominant use of digital modulation schemes, with their almost flat signal spectra, means that the aggregate interference from both polarizations in the adjacent satellite is essentially independent of the types of polarization used in adjacent satellites. This matter has been studied extensively in the ITU Working Party 4A.[19]

Finally, the use of circular polarization in the extended Ku-band will ensure the same high level of frequency re-use as if linear polarization were used.[20]

VIII. COMPLIANCE WITH COMMISSION RULES

The proposed satellite is compatible with the Commission's two-degree spacing requirements and will not cause harmful interference to any authorized user of the spectrum. Except where waivers have been requested, it also complies with all technical and non-technical requirements of Part 25 of the Rules, as amended by the *FCFS Order*. Specifically, EchoStar will comply with all applicable power flux density limits[21] and with the Commission's full

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[19] *See* the Chairman's Report of Working Party 4A meetings held in September 2000 and April 2001, based in part on US contributions.

[20] *See PanAmSat Licensee Corp.*, *Report and Order*, SAT-LOA-20011221-00134, SAT-WAV-20020322-00031 (rel. May 8, 2002) ("We find that granting PanAmSat's waiver request [to use circular polarization for certain transponders] would not undermine our policy. PanAmSat represents that its transponders will achieve full frequency reuse.")

[21] *See* 47 C.F.R. §§ 25.208(b).

frequency reuse requirements.[22] Except where waivers have been requested, EchoStar also commits to comply with all of the Commission Rules applicable to GSO FSS satellites operating in the extended Ku-band.

IX. ORBITAL DEBRIS MITIGATION

Pursuant to 47 C.F.R. § 25.217(d), applicants requesting a satellite authorization must submit a narrative statement describing the debris mitigation design and operational strategies, if any, that they will use.

To control orbital debris, EchoStar will use a design for its satellite and launch vehicle that minimizes the amount of debris released during normal operations. To ensure that its satellite does not become a source of orbital debris, EchoStar will conduct an analysis to ensure that the probability of collision with any known space borne objects during its normal operational lifetime is minimal. EchoStar will also conduct an analysis that demonstrates that no realistic failure modes exist or can lead to an accidental explosion during normal operations or before completion of post operations disposal. At the end of the operational life of the satellite, EchoStar will maneuver its spacecraft to a storage orbit with a perigee altitude above its normal operational orbit. EchoStar will use a maneuver strategy that reduces the risk of leaving any of its spacecraft near an operational orbit. After the satellite reaches its final disposal orbit, all on-board sources of stored energy will be depleted or safely secured.

X. ITU COST RECOVERY

EchoStar is aware that as a result of the actions taken at the 1998 Plenipotentiary Conference, as modified by the International Telecommunication Union ("ITU") Council in June 2001, processing fees will now be charged by the ITU for satellite network filings. As a

[22] *See* 47 C.F.R. § 25.210(f).

consequence, Commission applicants are responsible for any and all fees charged by the ITU. EchoStar hereby states that it is aware of and unconditionally accepts this requirement and its responsibility to pay any ITU cost recovery fees for the ITU filings associated with this application. Invoices for such fees may be sent to the contact representative listed in the accompanying Form 312.

XI. CONCLUSION

For the foregoing reasons, EchoStar respectfully requests that the Commission promptly approve this application as in the public interest, convenience and necessity.

Respectfully submitted,

EchoStar Satellite Corporation

__________/s/________________________
David K. Moskowitz
Senior Vice President and General Counsel
EchoStar Satellite Corporation
9601 South Meridian Blvd.
Englewood, CO 80112
(303) 723-1000

Pantelis Michalopoulos
Philip L. Malet
Chung Hsiang Mah
Steptoe & Johnson LLP
1330 Connecticut Avenue N.W.
Washington, D.C. 20036
(202) 429-3000

Counsel for EchoStar Satellite Corporation

Exhibit 1

TECHNICAL ANNEX

CERTIFICATION OF PERSON RESPONSIBLE FOR PREPARING ENGINEERING INFORMATION

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in this pleading, that I am familiar with Part 25 of the Commission's rules that I have either prepared or reviewed the engineering information submitted in this pleading, and that it is complete and accurate to the best of my knowledge and belief.

_____________/s/_______________
Richard Barnett
Telecomm Strategies Inc.
6404 Highland Drive
Chevy Chase, MD 20815
(301) 656-8969

ECHOSTAR-109W

ATTACHMENT A
TECHNICAL DESCRIPTION

A.1 GENERAL DESCRIPTION

The EchoStar-109W satellite will operate at the 109°W.L. orbital location to provide FSS ("Fixed Satellite Service") services to North and Central America. The satellite will use the 10.95-11.2 GHz and 11.45-11.7 GHz ("Extended Ku-band") downlink bands and the 13.75-14.0 GHz ("Extended Ku-band") uplink band.

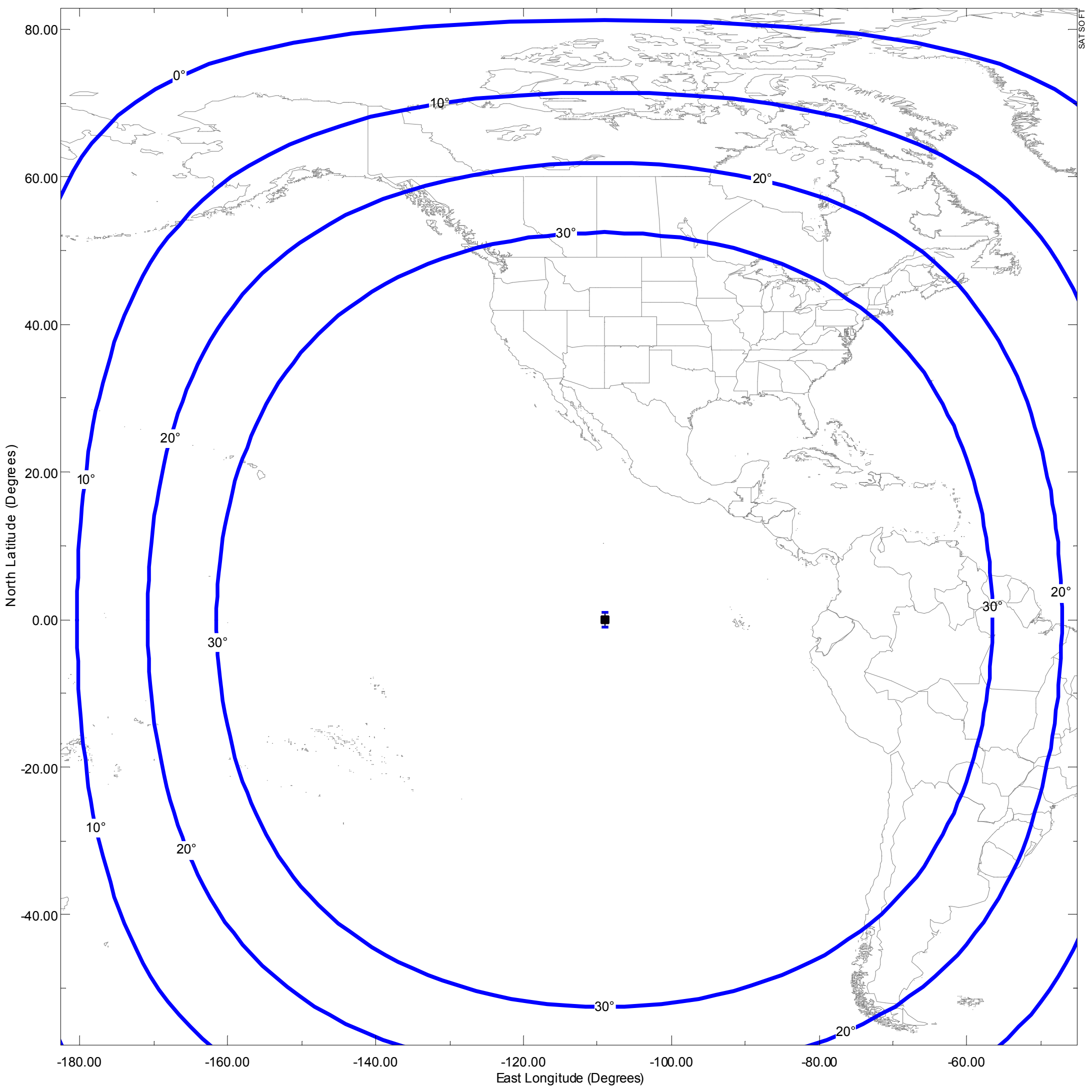
There will be 32 transponders each of 27 MHz usable bandwidth, meaning full frequency reuse of the 500 MHz downlink frequencies and both full frequency and spatial reuse of the 250 MHz uplink frequencies. The extended Ku-band transponders will operate using a broad coverage beam on the downlink, and with two small, geographically isolated spot beams on the uplink to achieve the necessary uplink frequency re-use.

A.2 ORBITAL LOCATION

EchoStar requests Commission authority to use the 109°W.L. geostationary orbital location for the EchoStar-109W satellite. This available orbital location has been selected because, among other things, it provides high elevation angles to all of North and Central America, which is very important for satellite services to large numbers of small and inexpensive consumer earth stations. The high elevation minimizes the risk of signal blockage due to buildings and foliage, and also minimizes the atmospheric and rain attenuation.

Figure A.2-1 shows the elevation angles to the 109°W.L. orbital location from the service areas of the proposed EchoStar-109W satellite. Note that the majority of CONUS is above the 30° elevation angle and the most populated portions of Canada are above the 20° elevation angle. The only parts of the CONUS service areas that are below 30° are parts of North East CONUS (where the elevation angle is still greater than 20°).

Figure A.2-1 – Elevation Angles to the 109°W.L. Orbital Location



A.3 SATELLITE COVERAGE

Sections A.5 and A.6 provide full details of the antenna beams used to provide these satellite coverages.

The EchoStar-109W satellite will provide one-way direct-to-home ("DTH") satellite and other fixed satellite services at extended Ku-band frequencies to CONUS, Alaska, Hawaii, Puerto Rico and the US Virgin Islands, as well as to other parts of North and Central America and the Caribbean, including Canada and Mexico. The extended Ku-band beam coverage consists of a single large downlink beam and two small uplink spot beams used for the feeder links.[1]

A.4 FREQUENCY AND POLARIZATION PLANS

The EchoStar-109W satellite frequency plan is given in Table A.4-1, indicating transponder center, upper and lower frequencies, as well as transponder polarizations.

The transponders are of nominal 27 MHz usable bandwidth, with a spacing between transponder center frequencies of 30 MHz. Both the uplink and the downlink polarizations are switchable between linear and circular. The cross-polar transponders are offset by 10 MHz relative to the co-polar ones in order to achieve additional isolation resulting from the guard bands.

TT&C operations will take place in portions of the main service link frequency ranges of the satellite, as discussed in detail in Section A.19. Exact frequency plans for the TT&C transmissions are not yet available.

1 §25.204(f) currently restricts FSS earth station antenna diameters in the 13.75-14.0 GHz band to a minimum size of 4.5 meters. Should the Commission relax this restriction in the future as a result of decisions taken at the 2003 World Radiocommunications Conference, EchoStar reserves the right to make a future modification to the satellite's receive beams in order to allow for the provision of two-way services.

Table A.4-1 - Transponder Frequency Plan for Extended Ku-Band

		UPLINK				DOWNLINK			
Txpdr #		Pol'n	Center Freq	F_{low}	F_{high}	Pol'n	Center Freq	F_{low}	F_{high}
KuX - 1	Uplink Beam A	HP or LHCP	13,765.00	13,751.50	13,778.50	VP or RHCP	10,965.00	10,951.50	10,978.50
KuX - 2		VP or RHCP	13,775.00	13,761.50	13,788.50	VP or RHCP	10,995.00	10,981.50	11,008.50
KuX - 3		HP or LHCP	13,795.00	13,781.50	13,808.50	VP or RHCP	11,025.00	11,011.50	11,038.50
KuX - 4		VP or RHCP	13,805.00	13,791.50	13,818.50	VP or RHCP	11,055.00	11,041.50	11,068.50
KuX - 5		HP or LHCP	13,825.00	13,811.50	13,838.50	VP or RHCP	11,085.00	11,071.50	11,098.50
KuX - 6		VP or RHCP	13,835.00	13,821.50	13,848.50	VP or RHCP	11,115.00	11,101.50	11,128.50
KuX - 7		HP or LHCP	13,855.00	13,841.50	13,868.50	VP or RHCP	11,145.00	11,131.50	11,158.50
KuX - 8		VP or RHCP	13,865.00	13,851.50	13,878.50	VP or RHCP	11,175.00	11,161.50	11,188.50
KuX - 9		HP or LHCP	13,885.00	13,871.50	13,898.50	VP or RHCP	11,465.00	11,451.50	11,478.50
KuX - 10		VP or RHCP	13,895.00	13,881.50	13,908.50	VP or RHCP	11,495.00	11,481.50	11,508.50
KuX - 11		HP or LHCP	13,915.00	13,901.50	13,928.50	VP or RHCP	11,525.00	11,511.50	11,538.50
KuX - 12		VP or RHCP	13,925.00	13,911.50	13,938.50	VP or RHCP	11,555.00	11,541.50	11,568.50
KuX - 13		HP or LHCP	13,945.00	13,931.50	13,958.50	VP or RHCP	11,585.00	11,571.50	11,598.50
KuX - 14		VP or RHCP	13,955.00	13,941.50	13,968.50	VP or RHCP	11,615.00	11,601.50	11,628.50
KuX - 15		HP or LHCP	13,975.00	13,961.50	13,988.50	VP or RHCP	11,645.00	11,631.50	11,658.50
KuX - 16		VP or RHCP	13,985.00	13,971.50	13,998.50	VP or RHCP	11,675.00	11,661.50	11,688.50
KuX - 17	Uplink Beam B	VP or RHCP	13,765.00	13,751.50	13,778.50	HP or LHCP	10,975.00	10,961.50	10,988.50
KuX - 18		HP or LHCP	13,775.00	13,761.50	13,788.50	HP or LHCP	11,005.00	10,991.50	11,018.50
KuX - 19		VP or RHCP	13,795.00	13,781.50	13,808.50	HP or LHCP	11,035.00	11,021.50	11,048.50
KuX - 20		HP or LHCP	13,805.00	13,791.50	13,818.50	HP or LHCP	11,065.00	11,051.50	11,078.50
KuX - 21		VP or RHCP	13,825.00	13,811.50	13,838.50	HP or LHCP	11,095.00	11,081.50	11,108.50
KuX - 22		HP or LHCP	13,835.00	13,821.50	13,848.50	HP or LHCP	11,125.00	11,111.50	11,138.50
KuX - 23		VP or RHCP	13,855.00	13,841.50	13,868.50	HP or LHCP	11,155.00	11,141.50	11,168.50
KuX - 24		HP or LHCP	13,865.00	13,851.50	13,878.50	HP or LHCP	11,185.00	11,171.50	11,198.50
KuX - 25		VP or RHCP	13,885.00	13,871.50	13,898.50	HP or LHCP	11,475.00	11,461.50	11,488.50
KuX - 26		HP or LHCP	13,895.00	13,881.50	13,908.50	HP or LHCP	11,505.00	11,491.50	11,518.50
KuX - 27		VP or RHCP	13,915.00	13,901.50	13,928.50	HP or LHCP	11,535.00	11,521.50	11,548.50
KuX - 28		HP or LHCP	13,925.00	13,911.50	13,938.50	HP or LHCP	11,565.00	11,551.50	11,578.50
KuX - 29		VP or RHCP	13,945.00	13,931.50	13,958.50	HP or LHCP	11,595.00	11,581.50	11,608.50
KuX - 30		HP or LHCP	13,955.00	13,941.50	13,968.50	HP or LHCP	11,625.00	11,611.50	11,638.50
KuX - 31		VP or RHCP	13,975.00	13,961.50	13,988.50	HP or LHCP	11,655.00	11,641.50	11,668.50
KuX - 32		HP or LHCP	13,985.00	13,971.50	13,998.50	HP or LHCP	11,685.00	11,671.50	11,698.50

Notes:

1. Uplink frequencies in transponders KuX-17-32 are identical to those in transponders KuX-1-16 because of spatial frequency re-use between Uplink Beam A and B.

2. The uplinks for all 32 transponders are switchable in a single group between linear and circular polarization. Similarly, the downlinks for all 32 transponders are switchable in a single group between linear and circular polarization. The type of polarization (CP or LP) may be the same or different between uplinks and downlinks.

A.5 SATELLITE TRANSMIT CAPABILITY

Figure A.5-1 shows the relative gain contours for the downlink beam. The peak antenna gain is 33.5 dBi. Higher gain is provided in the south-east of CONUS to combat the high rain attenuation.

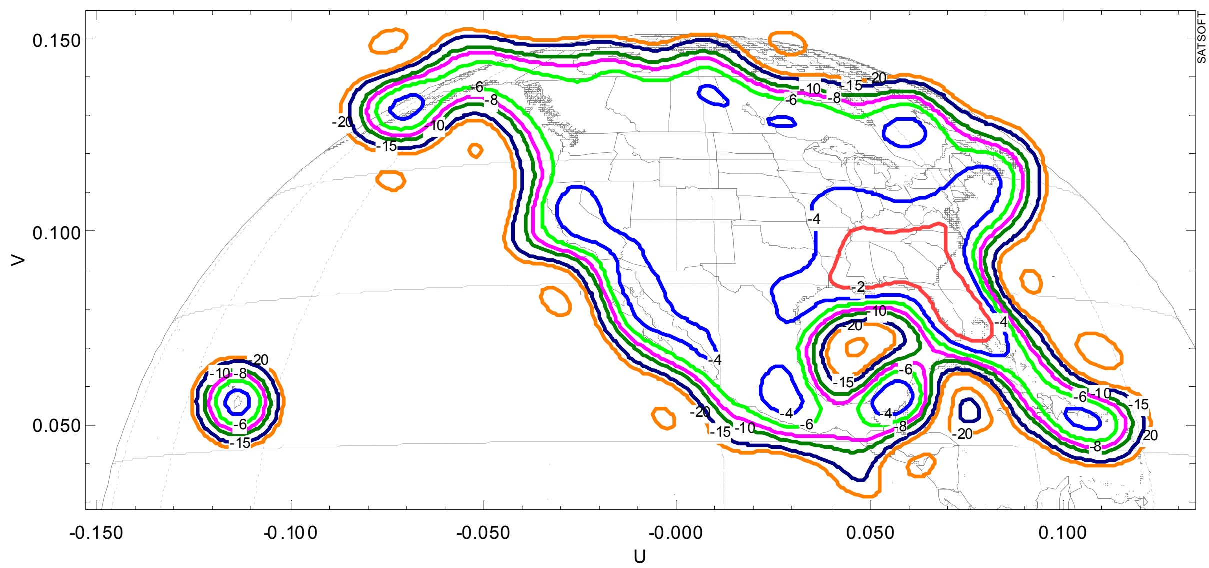
Each transponder will use a 200 Watt TWTA, providing approximately 23 dBW saturated power at the TWTA output. The losses between the TWTA output and the antenna input amount to 1.7 dB.

The resulting beam peak saturated EIRP level for these transponders will be 54.8 dBW (i.e., 33.5+23-1.7). All of CONUS is within the –6 dB relative gain contour and therefore will receive an EIRP of greater than 48 dBW, with EIRP levels between 4 and 6 dB higher in the south-east of CONUS. Other parts of the service area (Canada, Mexico, the Caribbean, Alaska and Hawaii) receive an EIRP level generally in excess of 47 dBW.

The cross-polar isolation of the satellite transmit antennas will exceed 30 dB within the -8 dB gain contour at all transmit frequencies.

Figure A.5-1 – Downlink Beam Coverage

(Contours shown are -2, -4, -6, -8, -10, -15, and -20 dB relative to the beam peak)



A.6 SATELLITE RECEIVE CAPABILITY

The satellite will utilize two steerable receive beams for feeder link uplink transmissions. Both beams will be capable of being independently steered to any part of the visible Earth and the baseline configuration will be to use to use uplink transmissions from outside the USA. In order to provide full spatial frequency re-use of the uplink spectrum the two beams must be pointed sufficiently far apart from each other to create the necessary beam isolation. The final beam pointing directions for the two beams has not yet been determined, but Figure A.6-1 shows examples of the beams pointing towards Mexico City, Mexico, and Lima, Peru, and gives the necessary relative gain contours.

Alternatively, one of the two steerable receive spot beams may be used to receive uplink transmissions from a feeder link earth station located in Cheyenne, WY. Figure A.6-2 shows the beam contours for that spot beam in the event this uplink configuration is employed.

The peak receive antenna gain for both receive antennas is 44.4 dBi. However, in order not to make the feeder uplink over-sensitive to interference from transmissions to adjacent satellite networks, an adjustable attenuator with a range of 15 dB in 1 dB steps is employed between the receive antenna and the first active amplifier in the receiver chain of the satellite. As a result of this, the effective beam peak G/T as seen by the receiver chain ranges between 16.4 dB/K and to 1.4 dB/K.

The cross-polar isolation of the satellite receive antenna used for the feeder uplinks to the conventional downlink transponders exceeds 30 dB within the -4 dB gain contour at all receive frequencies.

Figure A.6-1 – Feeder Uplink Steerable Beams

(Example pointing directions towards Mexico City and Lima)

(Contours shown are -2, -4, -6, -8, -10, -15 and -20 dB relative to the beam peak)

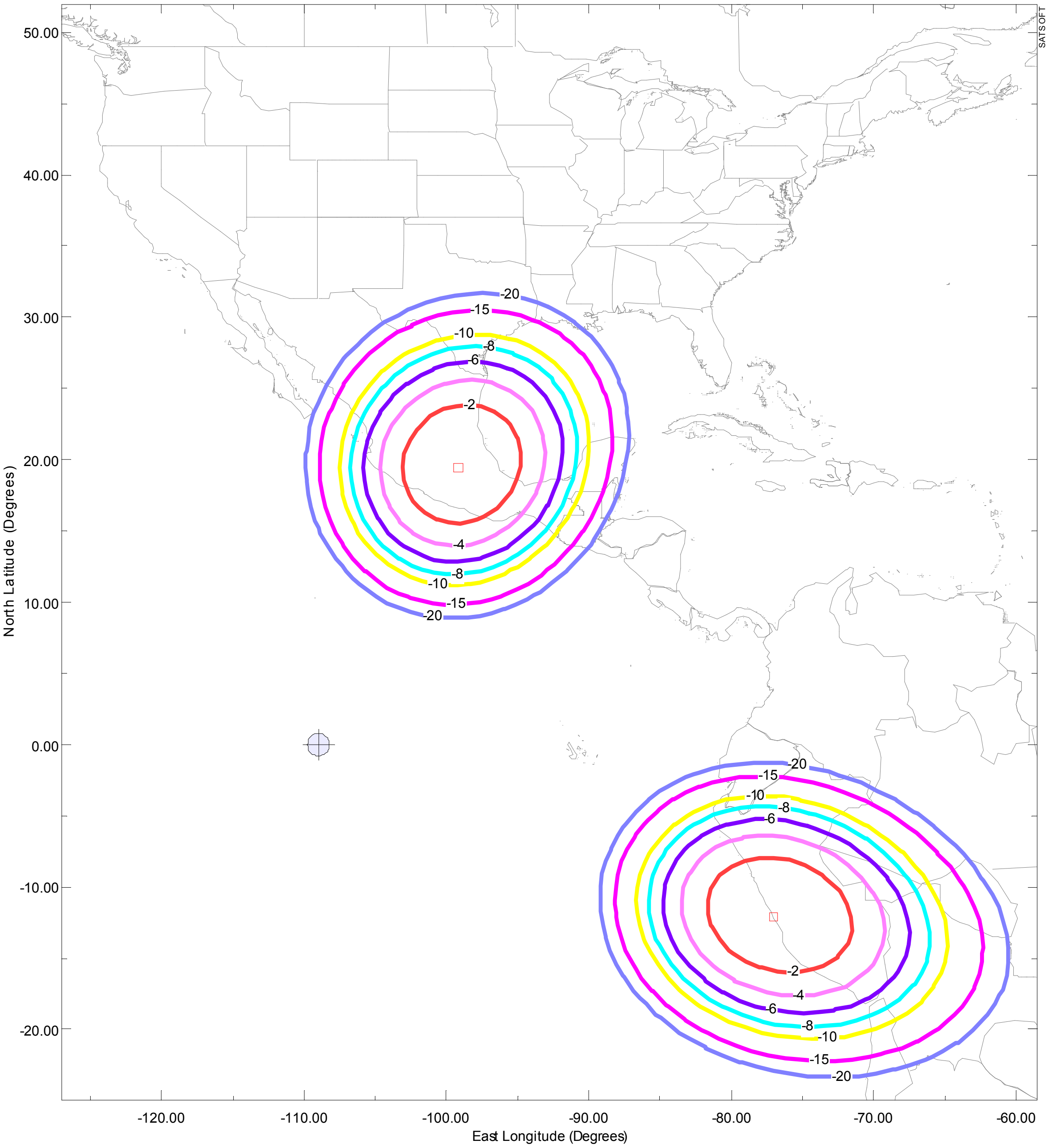
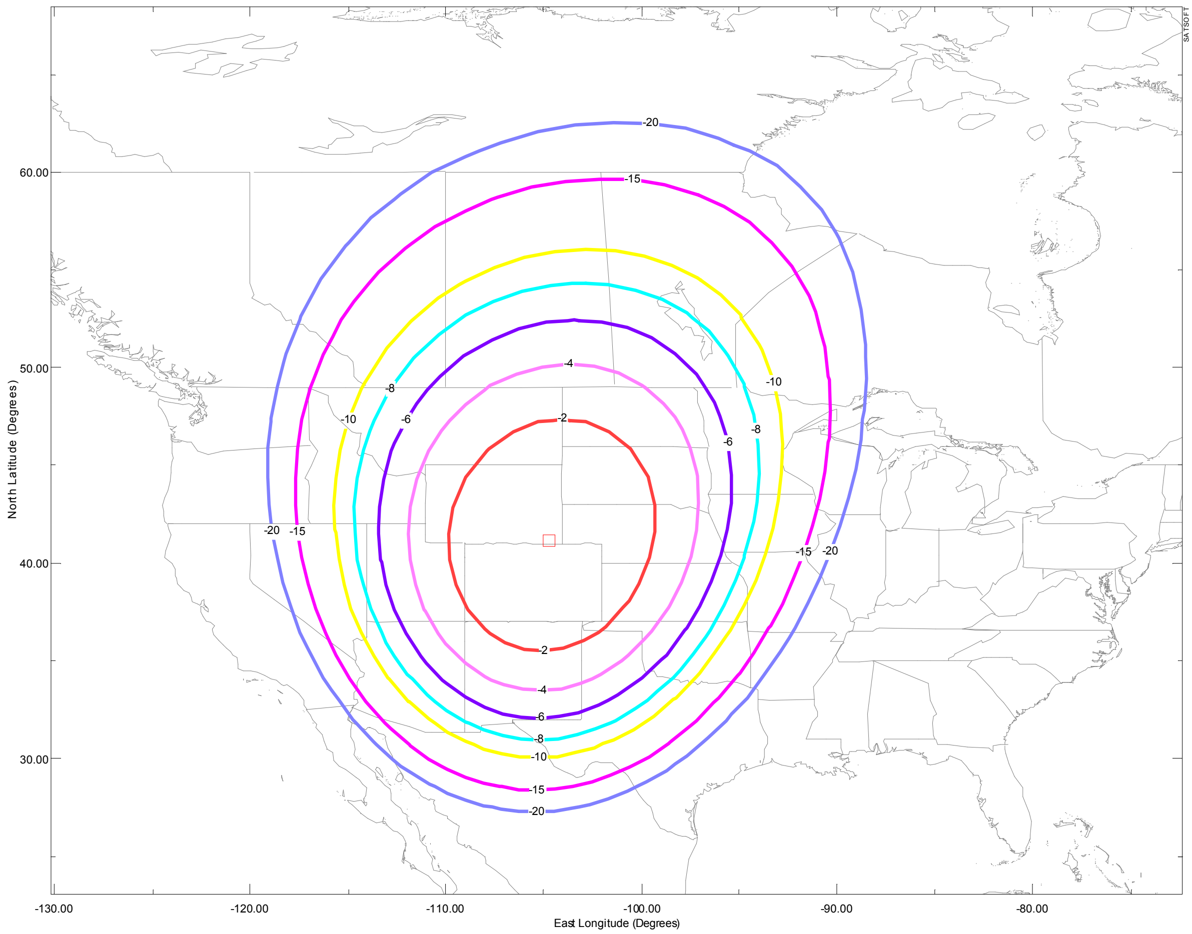


Figure A.6-2 – Feeder Uplink Steerable Beam

(Pointing towards Cheyenne, WY)

(Contours shown are -2, -4, -6, -8, -10, -15 and -20 dB relative to the beam peak)



A.7 TRANSMISSION SCHEMES

The transponders in the EchoStar-109W satellite are of the conventional bent-pipe type, with channel filtering consistent with the transponder bandwidths. In these transponders the same transmission scheme will be used on both uplink and downlink for the same transponder. Digital modulation will be used throughout. The main operating mode for these transponders will be for a DTH application, where the feeder uplinks consist of a digital multiplex modulated onto a single carrier, and operating close to saturation of the transponder. The digital multiplex will be received by large numbers of small ground receive terminals, each capable of being programmed to receive certain information from the multiplex.

A.8 TRANSPONDER GAIN CONTROL AND SATURATION FLUX DENSITY

The gain of each transponder between the output of the receiving antenna and the input to the transmitting antenna is approximately 120 dB. Automatic Level Control ("ALC") will be used in order to maintain the transponders operating at or very close to TWTA saturation, even in the presence of uplink signal fades due to rain attenuation effects. At receive beam peak the ALC has the effect of adjusting the SFD from –76.4 to –96.4 dBW/m^2. To maintain correct operation over the range of foreseen conditions the ALC will have a dynamic range of 20 dB.[2]

A.9 SATELLITE TRANSPONDER FILTER RESPONSE

The specification for the overall transponder in-band filter response and out-of-band attenuation will be similar to that used on existing Ku-band FSS satellites. The performance in these respects is dictated by the following considerations:

1. The in-band gain and group delay response must be flat enough so as not to degrade significantly the bit error rate performance of the digital carrier in the transponder;
2. The out-of-band attenuation must be high enough, in the adjacent transponder frequency band, to suppress adequately the multi-path transmission through adjacent transponders.

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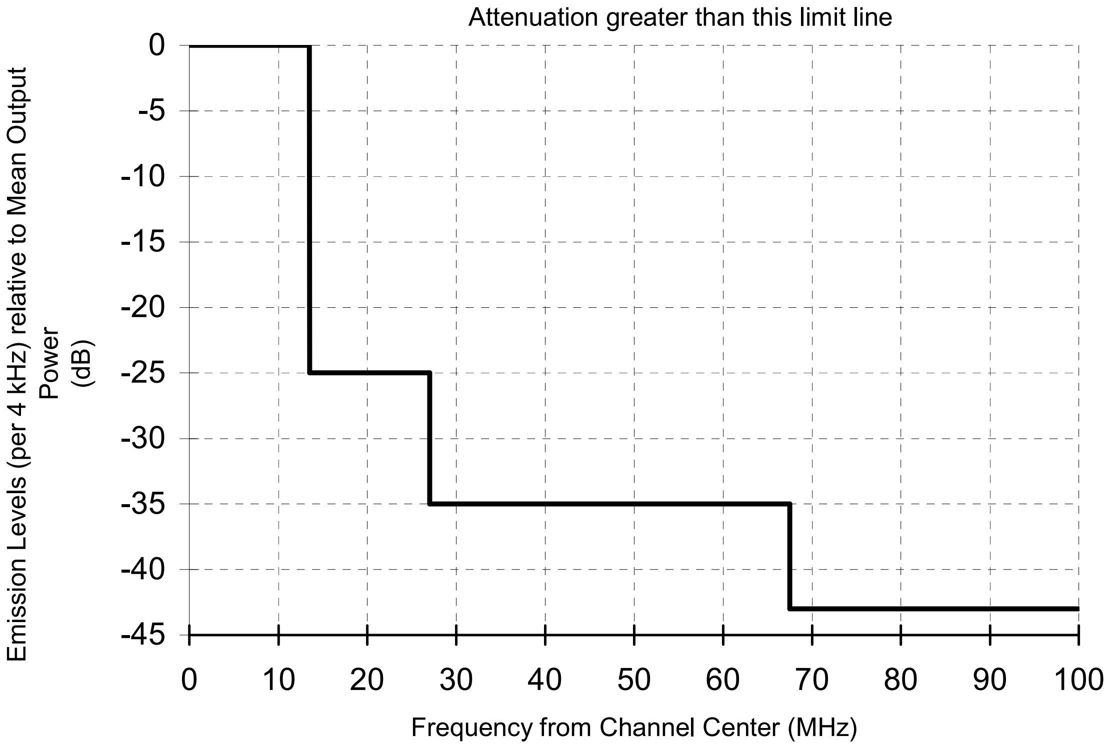
[2] Exact value of dynamic range available will depend on the satellite manufacturer.

3. The out-of-band attenuation must also be sufficient to suppress any unwanted signals in frequency bands adjacent to the transponder frequency band, which could otherwise cause overload of the active amplifiers in the communications payload, or waste the available power of the TWTAs.

A.10 UNWANTED EMISSIONS

The out-of-band emissions will not exceed the mask given in Figure A.10-1 below.

Figure A.10-1 – Unwanted Emission Mask



A.11 EMISSION DESIGNATORS AND ALLOCATED BANDWIDTH OF EMISSION

The emission designator is 27M0G7W. This has an allocated bandwidth of 27 MHz.

For TT&C the emission designators will be as follows:

Telecommand (including ranging):	1M00F2D
Telemetry (including ranging):	1M00F2D

A.12 EARTH STATIONS

The primary subscriber receive earth station to be used with the EchoStar-109W satellite will be a 90 cm antenna. Such terminals are expected to be deployed in large numbers across the service areas (several millions). In some areas and for certain applications, where higher clear-sky performance is required, larger antennas may be used (typically 100 cm, 120 cm, 150 cm or 180 cm). The feeder uplink earth stations (main and back-up) will use an 11 meter or larger antenna.

A.13 LINK BUDGETS

Tables A.13-1 and A.13-2 provide representative link budgets for the DTH link from the transmitting feeder link earth stations to the subscriber receive earth stations, for the case of feeder link earth stations located in Mexico City and Lima, Peru. Both clear sky and rain faded downlink budgets are shown – the latter for both New York (rain region K) and Los Angeles (rain region E). Availability in excess of 99.99% is achieved. The link budgets show only downlink rain fades because uplink rain fades are compensated by a combination of uplink power control at the transmitting earth station and ALC in the satellite.

A similar link budget is provided for the alternative case of a feeder link earth station located in Cheyenne, WY. Similar results are obtained.

Table A.13-1 – Representative Link Budget for Uplink from Mexico City

EchoStar Extended Ku-Band Link Budget
(DTH Link)

Link Parameters		Clear Sky (New York)	Faded D/L (New York)	Faded D/L (Los Angeles)
Link Geometry:				
Tx E/S Range to Satellite (Mexico City)	(km)	36,314	36,314	36,314
Rx E/S Range to Satellite	(km)	38,532	38,532	37,125
Uplink (per carrier):				
Carrier Frequency	(MHz)	13,900	13,900	13,900
Tx E/S Antenna Diameter	(m)	11.0	11.0	11.0
Tx E/S Power to Antenna	(W)	20	20	20
Tx E/S Antenna Gain	(dB)	62.2	62.2	62.2
Tx E/S EIRP per Carrier	(dBW)	75.2	75.2	75.2
Atmospheric and Other Losses	(dB)	0.3	0.3	0.3
Free Space Loss	(dB)	206.5	206.5	206.5
Satellite:				
Gain Attenuation	(dB)	10.0	10.0	10.0
Equivalent G/T towards Tx E/S	(dB/K)	6.4	6.4	6.4
Sat'd EIRP	(dBW)	54.8	54.8	54.8
EIRP towards Rx E/S	(dBW)	52.0	52.0	50.0
Downlink (per carrier):				
Carrier Frequency	(MHz)	11,200	11,200	11,200
Atmospheric and Other Losses	(dB)	0.2	7.5	3.1
Free Space Loss	(dB)	205.1	205.1	204.8
Rx E/S Antenna Diameter	(m)	0.90	0.90	0.90
Antenna Mis-pointing Error	(dB)	0.50	0.50	0.50
Rx E/S Antenna Gain	(dB)	38.6	38.6	38.6
Rx E/S G/T	(dB/K)	17.5	13.8	15.3
System (LNA+Sky) Noise Temp.	(K)	130	302	214
Total Link:				
Carrier Noise Bandwidth	(kHz)	27,000	27,000	27,000
(C/N) - Thermal Uplink	(dB)	29.1	29.1	29.1
(C/N) - Thermal Downlink	(dB)	17.9	6.9	11.2
(C/I) - Other Link Degradations	(dB)	15.0	15.0	15.0
(C/N) - Total Actual	(dB)	13.1	6.3	9.6
(C/N) - Total Required	(dB)	6.0	6.0	6.0
Excess Margin	(dB)	7.1	0.3	3.6

Table A.13-2 – Representative Link Budget for Uplink from Lima, Peru

EchoStar Extended Ku-Band Link Budget (DTH Link)				
Link Parameters		**Clear Sky (New York)**	**Faded D/L (New York)**	**Faded D/L (Los Angeles)**
Link Geometry:				
Tx E/S Range to Satellite (Lima, Peru)	(km)	38,063	38,063	38,063
Rx E/S Range to Satellite	(km)	38,532	38,532	37,125
Uplink (per carrier):				
Carrier Frequency	(MHz)	13,900	13,900	13,900
Tx E/S Antenna Diameter	(m)	11.0	11.0	11.0
Tx E/S Power to Antenna	(W)	20	20	20
Tx E/S Antenna Gain	(dB)	62.2	62.2	62.2
Tx E/S EIRP per Carrier	(dBW)	75.2	75.2	75.2
Atmospheric and Other Losses	(dB)	0.3	0.3	0.3
Free Space Loss	(dB)	206.9	206.9	206.9
Satellite:				
Gain Attenuation	(dB)	10.0	10.0	10.0
Equivalent G/T towards Tx E/S	(dB/K)	6.4	6.4	6.4
Sat'd EIRP	(dBW)	54.8	54.8	54.8
EIRP towards Rx E/S	(dBW)	52.0	52.0	50.0
Downlink (per carrier):				
Carrier Frequency	(MHz)	11,200	11,200	11,200
Atmospheric and Other Losses	(dB)	0.2	7.5	3.1
Free Space Loss	(dB)	205.1	205.1	204.8
Rx E/S Antenna Diameter	(m)	0.90	0.90	0.90
Antenna Mis-pointing Error	(dB)	0.50	0.50	0.50
Rx E/S Antenna Gain	(dB)	38.6	38.6	38.6
Rx E/S G/T	(dB/K)	17.5	13.8	15.3
System (LNA+Sky) Noise Temp.	(K)	130	302	214
Total Link:				
Carrier Noise Bandwidth	(kHz)	27,000	27,000	27,000
(C/N) - Thermal Uplink	(dB)	28.7	28.7	28.7
(C/N) - Thermal Downlink	(dB)	17.9	6.9	11.2
(C/I) - Other Link Degradations	(dB)	15.0	15.0	15.0
(C/N) - Total Actual	(dB)	13.1	6.3	9.6
(C/N) - Total Required	(dB)	6.0	6.0	6.0
Excess Margin	(dB)	7.1	0.3	3.6

Table A.13-1 – Representative Link Budget for Uplink from Cheyenne, WY

EchoStar Extended Ku-Band Link Budget
(DTH Link)

Link Parameters		Clear Sky (New York)	Faded D/L (New York)	Faded D/L (Los Angeles)
Link Geometry:				
Tx E/S Range to Satellite (Cheyenne)	(km)	37,610	37,610	37,610
Rx E/S Range to Satellite	(km)	38,532	38,532	37,125
Uplink (per carrier):				
Carrier Frequency	(MHz)	13,900	13,900	13,900
Tx E/S Antenna Diameter	(m)	11.0	11.0	11.0
Tx E/S Power to Antenna	(W)	20	20	20
Tx E/S Antenna Gain	(dB)	62.2	62.2	62.2
Tx E/S EIRP per Carrier	(dBW)	75.2	75.2	75.2
Atmospheric and Other Losses	(dB)	0.3	0.3	0.3
Free Space Loss	(dB)	206.8	206.8	206.8
Satellite:				
Gain Attenuation	(dB)	10.0	10.0	10.0
Equivalent G/T towards Tx E/S	(dB/K)	6.4	6.4	6.4
Sat'd EIRP	(dBW)	54.8	54.8	54.8
EIRP towards Rx E/S	(dBW)	52.0	52.0	50.0
Downlink (per carrier):				
Carrier Frequency	(MHz)	11,200	11,200	11,200
Atmospheric and Other Losses	(dB)	0.2	7.5	3.1
Free Space Loss	(dB)	205.1	205.1	204.8
Rx E/S Antenna Diameter	(m)	0.90	0.90	0.90
Antenna Mis-pointing Error	(dB)	0.50	0.50	0.50
Rx E/S Antenna Gain	(dB)	38.6	38.6	38.6
Rx E/S G/T	(dB/K)	17.5	13.8	15.3
System (LNA+Sky) Noise Temp.	(K)	130	302	214
Total Link:				
Carrier Noise Bandwidth	(kHz)	27,000	27,000	27,000
(C/N) - Thermal Uplink	(dB)	28.8	28.8	28.8
(C/N) - Thermal Downlink	(dB)	17.9	6.9	11.2
(C/I) - Other Link Degradations	(dB)	15.0	15.0	15.0
(C/N) - Total Actual	(dB)	13.1	6.3	9.6
(C/N) - Total Required	(dB)	6.0	6.0	6.0
Excess Margin	(dB)	7.1	0.3	3.6

The representative link budgets show that the uplink EIRP is 75.2 dBW for the 27 MHz carrier. §25.204(f) states that the uplink EIRP in the 13.77-13.78 GHz band shall not exceed 71 dBW in any 6 MHz. The uplink EIRP of 75.2 dBW across 27 MHz is equivalent to 68.7 in any 6 MHz, thereby complying with §25.204(f). In other parts of the 13.75-14.0 GHz band, the attenuation setting may be changed such that the uplink EIRP exceeds 71 MHz in any 6 MHz, however this level will not be exceeded within the 13.77-13.78 GHz band.

A.14 STATION-KEEPING AND ANTENNA POINTING ACCURACY

The satellite orbital inclination and longitudinal drift will be maintained within ±0.05° of nominal. The antenna axis attitude will be maintained within ±0.12° of nominal during normal mode and ±0.15° of nominal during orbit maneuvers (i.e., station-keeping).

A.15 POWER FLUX DENSITY AT THE EARTH'S SURFACE

In the extended Ku-band there are Power Flux Density (PFD) limits in §25.208(b), as follows:

- -150 dB(W/m^2) in any 4 kHz band for angles of arrival between 0 and 5 degrees above the horizontal plane;
- -150+(δ-5)/2 dB(W/m^2) in any 4 kHz band for angles of arrival δ (in degrees) between 5 and 25 degrees above the horizontal plane; and
- -140 dB(W/m^2) in any 4 kHz band for angles of arrival between 25 and 90 degrees above the horizontal plane.

Compliance with these limits is demonstrated below for both high and low elevation angles.

The maximum saturated EIRP per transponder is 54.8 dBW. The shortest distance from the satellite to the Earth is 35,786 km, corresponding to a spreading loss of 162.06 dB. Therefore the maximum possible PFD at the Earth's surface could not exceed –107.3 dBW/m^2 in the 27 MHz transponder bandwidth (i.e., 54.8–162.06). Allowing for the use of digital modulation with an almost flat spectrum, the corresponding maximum PFD at the Earth's surface measured in a 4 kHz band would not exceed –145.6 dBW/m^2, which is 5.6 dB lower than the PFD limit applicable for angles of arrival greater than 25 degrees. Therefore, compliance with the PFD limits at high angles of arrival is assured.

An analysis was performed in order to verify that the PFD limits at low arrival angles are not exceeded. Table A.15-1 shows the results of an analysis that determined the highest downlink EIRP that occurs anywhere along the 0°, 5° and 25° angles of arrival. From the Table, it can be seen that the smallest amount of excess PFD margin is 0.2 dB, therefore compliance with the PFD limits of §25.208(b) at low angles of arrival is also assured.

Table A.15-1 – Worst Case PFD Levels at Low Arrival Angles

Angle of Arrival	Applicable PFD Limit for Angle of Arrival ($dBW/m^2/4$ kHz)	EchoStar-109W Satellite's Highest Downlink EIRP Level at Angle of Arrival (dBW/27 MHz)	EchoStar-109W Satellite's Worst Case PFD Level at Angle of Arrival ($dBW/m^2/4$ kHz)	Excess PFD Margin (dB)
0°	-150	51.2	-150.5	0.5
5°	-150	51.4	-150.2	0.2
25°	-140	51.7	-149.4	9.4

A.16 FREQUENCY TOLERANCE

The satellite local oscillator frequency stability will determine the accuracy of the frequency conversion between uplink and downlink transmissions. This frequency conversion error will not exceed ±5 in 10^6 under all circumstances.

A.17 CESSATION OF EMISSIONS

Each satellite transponder can be individually turned on and off by ground telecommand, thereby causing cessation of emissions from the satellite, as required.

A.18 LAUNCH VEHICLES

The spacecraft are compatible with several commercially available launch vehicles. A decision on the actual launcher to be used has not yet been made.

A.19 TT&C

The TT&C frequencies will be at the edges of the extended Ku-frequency bands. The final selection of TT&C frequencies within that band is partly dependent on the choice of spacecraft supplier, based on their preferred on-board TT&C equipment. It also depends on the availability of a global TT&C earth station network to support the Launch and Early Operations Phase ("LEOP") of the satellite mission. Therefore, EchoStar proposes to define the precise TT&C frequencies shortly after it selects the satellite manufacturer for the EchoStar-109W satellite. This will also take into account the coordination required with any neighboring satellites. At that time EchoStar will inform the Commission of its selected TT&C frequencies and request the necessary authorization.

Regardless of the exact TT&C frequencies used, the satellites will be configured to operate their TT&C functions through omni-directional spacecraft antennas during the LEOP, as well as in the event of a spacecraft emergency where attitude control might be disturbed. When operating correctly on-station the TT&C function will be switched to a high gain satellite antenna to permit lower power TT&C transmissions on both uplink and downlink.

Once the satellites are on-station EchoStar will use its existing Spacecraft Operations Center and TT&C earth station facilities to control the satellites.

A.20 SPACECRAFT CHARACTERISTICS

The spacecraft manufacturer for the EchoStar-109W satellite has not yet been selected, and EchoStar does not wish to show preference by providing any data specific to any one manufacturer in this application. The design of the satellite has been based around the expected characteristics of the 3-axis stabilized spacecraft available from the three major U.S. suppliers (Boeing, Lockheed Martin and Loral) in the time frame necessary for these satellites.

The communications payload of the EchoStar-109W satellite requires approximately 11.5 kW d.c. power. Total spacecraft power requirements are approximately 13.5 kW d.c. power which necessitates beginning of life solar array power production capability of approximately 14.5 kW. The communications payload mass (including antenna) will be approximately 275 kg which results in a total spacecraft dry mass of approximately 1975 kg. The total spacecraft launch mass is in the range 4200 to 4600 kg depending on launch vehicle selected. The satellite operational lifetime will be between 12 and 15 years.

The spacecraft reliability will be consistent with current manufacturing standards in place for the major suppliers of space hardware. Bus reliability will be greater than 0.8 with an overall spacecraft reliability of greater than 0.7. Transponder sparing will be consistent with documented failure rates which allow attaining the overall spacecraft reliability numbers listed above.

EchoStar will provide the Commission with full and precise spacecraft physical characteristics when the final supplier and product has been selected.

A.21 COMMUNICATIONS PAYLOAD

The communications payload will be conventional in architecture and very similar to EchoStar's existing Ku-band satellites. The main difference will be the exact frequency ranges over which the payload equipment has to operate.

The uplink signals in both senses of polarization will be received by each of the two satellite antennas (see Figures A.6-1 and A.6-2 for the beam characteristics), with the type of polarization (CP or LP) being switchable at the receive antenna feed. Limited filtering is then applied before amplification in the 13 GHz LNAs (Low Noise Amplifier) and further amplification and down-conversion (to the 11 GHz downlink frequencies) in the receivers. The outputs of the receivers (one active receiver for each polarization) will be channelized by the IMUX (Input Multiplexer) before further amplification and ALC/gain control in the CAMPs (Channel Amplifiers) and then the TWTAs (Traveling Wave Tube Amplifiers). The individual RF channels in the same polarization are then combined in the OMUXs (Output Multiplexers) and fed to the satellite transmit antenna, with appropriate feed switching provided to enable the use of either circular or linear polarization on the downlink. Appropriate redundancy switching is provided for all active payload equipment.

A.22 INTERFERENCE ANALYSIS (ADJACENT GSO SATELLITES)

Tables A.13-1 and A.13-2 show the link noise budget and overall performance for the EchoStar wideband carrier. The carrier is modulated using 4-phase PSK.

Currently, there are no satellites adjacent to the 109°W.L. location using the extended Ku-bands. Telesat Canada has plans to operate the ANIK-F2 satellite at the 111.1°W.L. location and the satellite is included on the FCC's Permitted Space Station List. This satellite will transmit telecommand carriers on a center frequency of 13.996 GHz from Canadian territory. Telesat is not licensed to transmit to the ANIK-F2 satellite using the 13.75-14.0 GHz band from the U.S. EchoStar will coordinate operations of its EchoStar-109W satellite with Telesat Canada under the ITU rules, as required.

Since there are no satellites at locations adjacent to the 109°W.L. location licensed to use the extended Ku-bands within the U.S., and in order to comply with §25.140(b)(2), it is necessary to make certain assumptions regarding the transmission parameters of a future adjacent satellite using the extended Ku-bands. In the interference analysis below, it is assumed that the adjacent satellite will transmit with the same uplink EIRP as for the EchoStar-109W satellite, albeit with a smaller transmitting earth station antenna of 4.5 meters. It is also assumed that the adjacent satellite's downlink EIRP is 2 dB less than that of the EchoStar-109W satellite.

Table A.22-1 provides a summary of the transmission parameters used in the interference analysis.

Table A.22-1 – Summary of R.F. parameters of the carriers used in the interference analysis

	ECHOSTAR-109W	**Adjacent Satellite**
RF Bandwidth (MHz)	27 MHz	27 MHz
Modulation	QPSK	QPSK
Uplink Earth Station Diameter (m)	11	4.5
Uplink Earth Station Gain (dBi)	62.2	54.5
Uplink Input Power (dBW)	13	20.7
Uplink EIRP (dBW)	75.2	75.2
Downlink EIRP (dBW)	54.8	52.8
Downlink Earth Station Diameter (m)	0.9	0.9
Downlink Earth Station Gain (dBi)	38.6	38.6
Single Entry C/I Criterion (dB)	19.2	19.2

The interference analysis assumes a geocentric orbital separation of 2 degrees and a topocentric angular separation of 2.2 degrees. It is assumed that all earth station antennas meet the off-axis gain requirement the 29-25log(θ) in the direction of the adjacent interfering satellite.

Table A.22.2 provides a summary of the interference analysis between the two satellite networks.

Table A.22-2 – Summary of interference calculations

	Interference into EchoStar-109W from the adjacent satellite	Interference from EchoStar-109W into the adjacent satellite
Uplink C/I (dB)	34.1	41.8
Downlink C/I (dB)	20.2	16.2
Overall C/I (dB)	20.0	16.1
C/I Criterion (dB)	19.2	19.2
C/I Margin (dB)	0.8	-3.1

Table A.22-2 shows a slightly positive overall interference margin into the EchoStar-109W satellite. There is a deficit of 3.1 dB into the assumed carrier of the future adjacent satellite. This small deficit can probably be absorbed by the adjacent operator or, alternatively, the adjacent operator can increase its downlink EIRP somewhat to improve the situation. In any event, it is expected that the two operators will be able to coordinate their respective operations.

A.23 SHARING ANALYSIS WITH OTHER SERVICES AND ALLOCATIONS

The 10.95-11.2 GHz and 11.45-11.7 GHz bands are shared on a co-primary basis with the Fixed Service ("FS"). The GSO FSS space station PFD limits of §25.208(b) have been developed for the protection of the FS in these frequency bands. Section A.15.1 demonstrates that the EchoStar-109W satellite will not exceed the PFD limits of §25.208(b) and therefore FS stations are adequately protected from interference. There also exists the potential for interference from FS stations into receive earth station terminals. EchoStar expects that its receive terminals can co-exist within this interference environment in most geographic areas of the country, while maintaining an acceptable quality of service. In areas where interference from FS transmitting stations into EchoStar-109W receiving earth stations might exceed an acceptable level, interference mitigation techniques will be employed. These include the careful selection of the installation location of the receive terminal in order to exploit natural and man-made blockage of the interfering signal to the maximum extent possible. Blockage of the FS signals will occur due to buildings and foliage, as well as the natural terrain. Additional receive earth station shielding can be employed if necessary by the addition of interference absorbing structures appended to the receive antennas.

The 13.75-14.0 GHz band is allocated domestically and internationally to the FSS, subject to certain restrictions contained in footnotes RRs 5.502 and 5.503 to the ITU's Radio Regulations. These restrictions are largely reflected domestically in §25.204(f) and §2.106.

As discussed in section A.12.1, and in conformance with §25.204(f), uplink transmissions to the EchoStar-109W satellite will not exceed an uplink EIRP of 71 MHz in any 6 MHz in the 13.77-13.78 GHz band. Further, uplink transmissions using the 13.75-14.0 GHz band will use an 11 m antenna, which is significantly larger than the smallest antenna (4.5 m) allowed under §25.204(f).

Regarding §2.106, EchoStar will coordinate its earth stations operating in the 13.75-13.80 GHz band with the National Telecommunications and Information Administration (NTIA) Interdepartment Radio Advisory Committee's Frequency Assignment Subcommittee, as required.

Exhibit 2

INTERNATIONAL COORDINATION

RAPPORT / REPORT / INFORME								
A	*A1a* Space station	USASAT-43D	*A1f* Notifying adm.	USA	*BR1* Date of receipt	10.06.2003	*BR20* IFIC no.	
BR6a/BR6b Id. no.	1						ADVP	E

B1a/B1b Beam designation: ADVP | *B2* Emi-Rcp: E | *B3a1/B3b1/B3b2a* Max. ant. gain:

BR7a/BR7b Group id. 3

C4a Class of station	EC	ED	EK
C4b Nature of service	CP	OT	OT

C6a Polarization type: | *C6b* Polarization angle:

C11a2 Service area: | *C11a3* Service area diagram:

A2a Date of bringing into use: 10.06.2008 | *A3a* Op. agency: | *A3b* Adm. resp.: | *BR16* Value of type C8b:

C1 Frequency Range			
From		To	
13.75	GHz	14	GHz

13C Remarks:

BR7a/BR7b Group id. 4

C4a Class of station	EC	EK	ER
C4b Nature of service	CP	OT	OT

C6a Polarization type: | *C6b* Polarization angle:

C11a2 Service area: | *C11a3* Service area diagram:

A2a Date of bringing into use: 10.06.2008 | *A3a* Op. agency: | *A3b* Adm. resp.: | *BR16* Value of type C8b:

C1 Frequency Range			
From		To	
10.95	GHz	11.2	GHz

13C Remarks:

BR7a/BR7b Group id. 5

C4a Class of station	EC	EK	ER
C4b Nature of service	CP	OT	OT

C6a Polarization type: | *C6b* Polarization angle:

C11a2 Service area: | *C11a3* Service area diagram:

A2a Date of bringing into use: 10.06.2008 | *A3a* Op. agency: | *A3b* Adm. resp.: | *BR16* Value of type C8b:

C1 Frequency Range			
From		To	
11.45	GHz	11.7	GHz

13C Remarks:

BR22 Administration remarks:

BR23 Radiocommunication Bureau comments: